DOCUMENT RESUME

ED 092 325 SE 015 160

AUTHOR Rosen, Marvin J.; Cohen, Arthur M.
TITLE An Evaluative Study of the University of California, Irvine/Golden West College Cooperative Science Improvement Project.
INSTITUTION Evaluation and Research Associates, Los Angeles, Calif.
PUB DATE Jun 72
NOTE 86p.

EDRS PRICE MF-$0.75 HC-$4.20 PLUS POSTAGE
DESCRIPTORS *Biology; College Science; *Community Colleges; *Individualized Instruction; *Inservice Education; *Multimedia Instruction; Science Education; Teacher Education
IDENTIFIERS California

ABSTRACT

This document contains a report of the University of California, Irvine, and Golden West College Cooperative Science Improvement Project (UCI/GWC Project) which was designed to address two major problems: (1) the difficulty faced by community college biology teachers in keeping pace with developments in their field and (2) the problem of conveying the content and excitement of biology in cases where traditional methods are inadequate. Two consecutive summer workshops, funded by the National Science Foundation, served to bring together subject matter specialists, instructional methods specialists, and community college biology teachers. Twenty-eight biology teachers representing 23 California community colleges were trained in recent advances in biology and in techniques for designing individualized, multi-media instruction for large numbers of students. Evaluation of the processes and impacts of the project was undertaken during the second summer workshop. The findings from this evaluation effort constitute the major portion of this report. (PEB)

*E*R*A*

EVALUATION AND RESEARCH ASSOCIATES

2010 LINNINGTON AVENUE
LOS ANGELES, CALIFORNIA
(213) 474-2C28 90025

ED 092325

U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

An Evaluative Study of the University of California, Irvine/Golden West College Cooperative Science Improvement Project

Marvin J. Rosen, Ed.D.
California State University, Fullerton

Arthur M. Cohen, Ph.D.
University of California, Los Angeles

June, 1972

SE 013 162

ACKNOWLEDGEMENTS

The evaluators wish to acknowledge the cooperation and assistance of the following persons in the preparation of this report:

Keith E. Justice, Ph.D.
Associate Professor of Biology
University of California, Irvine
Director, UCI/GWC Project

Hayden R. Williams
Professor of Biology
Golden West College, Huntington Beach, California
Co-director, UCI/GWC Project

Elizabeth R. Fox
Instructional Associate, UCI/GWC Project

In addition we wish to thank the many project participants, college administrators, and students who contributed much of the data on which this report is based.

MJR
AMC
1972

TABLE OF CONTENTS

I.	ABSTRACT	1
II.	BACKGROUND	3
III.	STATEMENT OF THE PROBLEM	6
IV.	METHOD OF THE EVALUATION	9
V.	THE FINDINGS	11
	Processes of the Institute	11
	Impacts of the Institute	13
VI.	INTERPRETATION AND RECOMMENDATIONS	26

APPENDICES:

A.	DATA-GATHERING INSTRUMENTS	29
B.	STATEMENT OF INSTITUTIONAL RECOMMENDATION AND SUPPORT	59
C.	LIST AND ABSTRACTS OF SELF-INSTRUCTIONAL MODULES DEVELOPED BY PARTICIPANTS	60
D.	EVALUATION OF ADAPTIVE-FLEXIBILITY PROTOCOLS OF COOPERATIVE SCIENCE IMPROVEMENT PROJECT PARTICIPANTS	71

I. ABSTRACT

The UCI/GWC Project (University of California, Irvine, and Golden West College Cooperative Science Improvement Project) was designed to address two major problems: 1) the difficulty faced by community college biology teachers in keeping pace with developments in their field, and 2) the problem of conveying the content and excitement of biology in cases where traditional methods are inadequate.

A National Science Foundation grant was awarded to the University of California, Irvine, to conduct a project with Golden West College, Huntington Beach, during 1969-71, which would bring together in two consecutive summer workshops subject matter specialists, instructional methods specialists, and community college biology teachers. It was expected that the participants would learn new principles and skills, develop new teaching materials, and return to their campuses to serve as resource persons in the design of systems-based, multi-media programs. Altogether, 28 biology teachers representing 23 California community colleges were trained in recent advances in biology and in techniques for designing individualized, multi-media instruction for large numbers of students. In addition, they developed "mini-packets" of self-instruction for their courses and shared these materials with other biology teachers.

An evaluation of the processes and impacts of the project was undertaken during the second summer workshop and reached the following summarized conclusions:

1. The project was conducted in accordance with the terms of its grant award. Partly due to excellent recruiting procedures, a highly motivated group of biology teachers participated.

2. The project was most effective in generating participant interest and skill in developing courses using individualized, multi-media methods, specific objectives, and a criterion-referenced approach. The project also stimulated limited changes in the content of certain biology courses.

3. Participants generally adopted at least some of the principles advocated in the institute. Most developed a heightened sense of accountability for the learning of their students and introduced at least some elements of self-instruction, and a criterion-referenced approach to teaching. Many planned and later implemented fully audiotutorialized courses on their campuses. Some of their courses were revised to include recent approaches and developments in biology.

4. Many institutions redirected resources into the planning and development of audiotutorial laboratories and programs as a consequence of the institute. This was more evident on campuses where new science facilities were in planning or construction. Many colleges supported the participants' efforts with intramural fellowships and released time.

5. The impact of the institute extended only in limited ways to the participants' departmental and campus colleagues, mostly in the form of shared information and answers to inquires.

6. Favorable effects on student achievement in the new and reconstructed courses were in evidence. Corroborative data from several sources were obtained in this area. Reliable effects of these courses on student attitudes toward learning could not be discerned. Some indication that student attitudes toward their courses functioned independently of the medium and method of instruction was detected.

7. No evidence of enhanced articulation with neighboring institutions as a consequence of the institute was found.

8. No reliable relationship between indexes obtained from the Adaptive-Flexibility Inventory (Brawer, 1967) and various measures of adoptive behavior could be found.

9. Participants identified major obstacles they found in trying to install new and reconstructed courses and curriculum modifications along lines advocated in the institute. They also related some of the methods they found successful in overcoming them.

II. BACKGROUND

Project UCI/GWC (University of California, Irvine, and Golden West College Cooperative Science Improvement Project) was designed to address two major problems: 1) the increasing difficulty faced by junior college biology teachers in keeping pace with rapid developments in the state of biological knowledge and research techniques, and 2) the problem of conveying the content and excitement of biological discovery where the usual lecture-laboratory teaching model is inadequate.

The project was designed to attack these problems by bringing together in two six week summer institutes a group of subject matter specialists from the University of California, Irvine, and elsewhere. A group of consulting instructional methods specialists, and a group of California junior college biology teachers including primarily instructors from member institutions of the League for Innovation in the Community College. These groups met at the two cooperating institutions and used the multi-media facilities at Golden West College. It was expected that the participants, following the upgrading of their own current knowledge and teaching skills, would carry back new information and techniques to their colleagues at their parent institutions.

A National Science Foundation grant was awarded to the University of California, Irvine, to conduct the project in cooperation with Golden West College. A joint directorship was set up with a faculty member from each of the cooperating institutions. The stated purposes of the project were to:

1. Provide a professional environment where subject matter specialists and college teachers can come together for the process of continuing self-renewal and self-study and development in that subject;

2. Improve the quality and quantity of learning within the framework of the present biology program for increasing numbers of students;

3. Increase instructors' ability to utilize integrated experience to student learning in specific fields of study;

4. Develop the instructors' ability to identify responses, attitudes, concepts and skills to be achieved by the students in relation to the integrated experience approach;

5. More effectively achieve student behavior identified as desirable by both student and instructor;

6. Develop methods, materials and learning experiences that will enable the student to direct his own activity toward attaining goals;

7. Evaluate the effectiveness of new teaching methods and materials developed in the project and to recommend on-going revisions for future curriculum changes based on the outcomes of the development;

8. Assist instructors to improve their teaching techniques by providing consultant and technical assistance as well as opportunities to actually develop program materials for use in their classrooms;

9. Assist participants in developing new course material including course content, references, visual and other instructional aids suitable for use as patterns and guides to facilitate and improve instructional programs in which they teach.

It was expected that participants completing the institutes would learn skills, develop materials and prepare to serve as resource persons to others in their institutions who would use a systems-based, multi-media approach.

The National Science Foundation grant was awarded effective July 1, 1969 to December 31, 1971, covering the planning and conduct of the two institutes during the summers of 1970 and 1971. Project planning activities were conducted during September, 1969 - June, 1970, in close cooperation with the California member institutions of the League. Applications were solicited from biology teachers directly, through the Deans of Instruction of the eligible institutions, and through announcements in professional publications and meetings.

The first institute was held on the UCI and GWC campuses during summer, 1970, with 25 biology instructors representing 23 California community colleges participating. During the 1970-71 academic year, following the first institute, participants developed new programs and materials for biology instruction on their home campuses with technical support from the project staff. A second institute was held during summer, 1971, on the GWC campus with 22 of the original participants returning and three new enrollees participating, representing 21 California community colleges. Further development of new programs and materials for biology instruction at their home institutions was planned by the participants for the 1971-72 academic year, although technical support from Project UCI/GWC was planned to terminate in December, 1971.

The 25 original participants were selected from among those applicants who seemed most committed to improving biology education and who had received strong institutional recommendations and statements of support. The two participants who did not return for the second summer institute were precluded from doing so because their home campus had underwritten an intensive summer effort to redesign courses and establish facilities for individualized, multi-media instruction as a consequence of their efforts following the first summer institute. Three new participants joined the project during the second summer institute, bringing the total of the second institute to 26 participants (4 women and 22 men). Altogether 28 biology teachers (4 women and 24 men) participated in all or a significant part of the project. Participants ranged in age from 29 to 49 years, the median age being 37 years.

Four major activities made up the institutes' summer programs: 1) presentations by subject matter specialists on recent advances in selected areas of biology, 2) in-class discussions and workshop activities on defining educational objectives in biology and designing media strategies for attaining them, 3) work

sessions with instructional designers on applying multi-media approaches to biology instruction, and 4) practical, supervised experience in designing, developing, and evaluating program segments in biology using the multi-media facilities at Golden West College.

During and following the first summer institute the staff conducted its own evaluation activities obtaining evaluative feedback from participants and consulting staff in order to assess the program's effectiveness. On the basis of such feedback, the program was modified somewhat during the first summer institute and these data figured importantly in planning for the second summer institute and the interim academic year.

To maintain and encourage communication among participants during the academic year, a periodic newsletter was circulated in which the new teaching practices and techniques of the participants were shared. In addition, the participants were organized into five regional groups which then met on occasion during the school year to share common problems and to seek solutions. Following the second summer institute, the program modules which had been developed by the participants were duplicated and distributed to all participants for their potential classroom use.

The evaluators were contracted at the start of the second summer institute to evaluate the project and its impacts on junior college biology teaching.

III. STATEMENT OF THE PROBLEM

The need to modify traditional approaches to junior college biology teaching is underscored by the accelerating rate at which new biological knowledge and research techniques are being generated and the accelerating rate of enrollments in the junior colleges. Teachers are faced with the task of teaching more information and skills to more students. Keeping pace with increasing numbers of students alone makes formidable the biology teacher's task of keeping abreast of the latest developments in biological science and methodology, not to mention the task of learning new ways of teaching.

This situation is not unique to biology education or even to science education. Similar pressures on the faculties of most other disciplines have been widely documented. In response to these pressures, many imaginative approaches to the conduct of instruction have been developing over the past decade which employ recent advances in communications and systems technology to better achieve instructional goals with large numbers of students. Significant pioneering contributions to these developments have been made by biology educators who were among the first to recognize the importance of applying new educational technology to assure quality learning in an age of expanding knowledge and enrollments.

Many junior colleges have been developing multi-media centers and audio-tutorial laboratories with a view toward facilitating the use of available hardware to carry on certain teaching functions, to free instructors from the repetitive functions of their activity, and to enable teachers to individualize their instruction for larger numbers of students. Through such pioneering efforts we can now document that successful instruction can be conducted through integrated, logical systems of instruction which employ such resources as sound tape recordings, film and slide projectors, time-shared computer terminals, videographic resources, machines designed for teaching and evaluation, and systematic application of psychological principles of learning. Improved systems of this type can provide students with diverse backgrounds, and various learning skills, aptitudes and interests with a more individualized tutorial approach to the learning process than is possible using the traditional lecture-laboratory teaching model.

While many educators are aware that the newer educational technologies may offer ways of increasing their effectiveness, few have found adequate opportunity to prepare and use these approaches without substantial support of their efforts. The major obstacle to rapid adoption of these innovative teaching practices has been the lack of adequate time and technical support for early adopters to be creative, to develop useful ideas, to update their course content, and to develop the materials and systems necessary to conduct individualized, multi-media instruction on a large scale. Those who have attempted to redesign their courses along these lines have found it essential to input an enormous amount of time and energy in learning new skills and in the development of special materials and procedures just to get ready to begin. To accomplish this while carrying a normal junior college teaching load has posed so great an obstacle as to frustrate the attempts by most instructors.

Accordingly, the University of California, Irvine, and Golden West College proposed a project that would enable a selected group of experienced junior college biology teachers, with the help of consultant specialists, to retrain themselves in the use of individualized, multi-media approaches developed around the most recent advances in biological knowledge and research methods. The benefits of the project were expected to be twofold: 1) the participants were expected to be updated in the most recent advances in biology and to develop skills and materials to implement individualized, multi-media instruction in their own courses, and 2) they were expected to return to their parent institutions as resource persons, there to function as change agents, stimulating the adoption of these approaches in their own schools and departments. Project UCI/GWC ultimately resulted in the training of 28 biology instructors, representing 23 California community colleges, in recent advances in biological science and in the principles and methods of designing individualized, multi-media instruction for large numbers of students. In addition, the participants designed and developed individualized instructional modules (dubbed "mini-packets") for use in their junior college biology courses. They then shared these materials among themselves and serviced a limited number of requests from faculties at other institutions.

In general, it was expected that the participants would return to their home institutions and seek to establish the facilities needed to conduct individualized, multi-media instruction in biology, such as audio-tutorial laboratories. In some cases, where such facilities already existed at their home campuses, participants were expected to redesign their courses in this mode. In addition, the participants were expected to function as resource persons and change agents, interacting with others at their campuses and elsewhere to facilitate adoption of these learning models.

The task of the evaluators was to determine the extent to which these expected outcomes were actually achieved following the institutes. Thus the evaluation focused upon the following specific objectives, or questions:

1. How effective were the processes and strategies of the institutes?

2. How have participants modified the content and methods of their courses?

3. How have participants modified their attitudes and approaches toward instruction?

4. How have the participants' parent institutions modified their curricula, facilities, and level and nature of support for science instruction?

5. How have the participants' colleagues modified their academic performance as a consequence, either directly or indirectly, of the participants' experience? (What "mirror effects" or "spinoffs" can be ascertained?)

6. How have the attitudes and achievements of the participants' students been affected by their "modified" courses?

7. How has articulation with feeder, receiving, and parallel institutions been changed as a consequence of the institutes?

8. What relationships can be ascertained between the participants' personality traits and their receptivity to modifying their courses and functioning as change agents?

9. What specific criticisms, comments, and suggestions are made by those affected by the project regarding future projects of similar intent?

This report summarizes the evaluation of Project UCI/GWC. The following sections will discuss the evaluation methods, the findings, the interpretation of the findings, and some recommendations pertaining to future projects of similar nature.

IV. METHOD OF THE EVALUATION

A two-member evaluation team was formed to design the study and the instruments, and to collect and analyze the data.

The method of the study was descriptive, for the most part, based upon summaries of data collected using multiple instruments with individuals affected directly or indirectly by the project. A correlational analysis was used to assess the relationships between certain personality characteristics of the participants, staff predictions of early adoption by participants of innovations learned in the institute, and ratings of actual adoptive behavior obtained nearly a year after the second summer institute. A correlational analysis was also used to assess the relationship between student attitudes toward their courses and the extent to which certain innovative methods learned in the institute were employed in those courses.

The evaluators conducted in-depth interviews with the project staff prior to the second summer institute to ascertain the objectives of the project. While the purposes of the project and many of its expected outcomes were stated in the proposal, the evaluators have found that many expected outcomes are often not specified in such planning documents. For this reason, the evaluation design was based upon both the planning documents and interview data obtained from the project staff and a sample of the project participants early in the second summer institute.

Toward the conclusion of the second summer institute, the participants Evaluation (Form A)[1], and the Workshop Evaluation (Form B) were administered to the 25 participants in the second summer institute to obtain opinions, criticisms, and suggestions regarding the conduct of the project and its perceived values for the participants. In addition, the Adaptive-Flexibility (A-F) Inventory (Brawer, 1967; Form C) was administered to 23 of the participants to assess the potential relationships between certain of their personality characteristics and their tendency to become early adopters of innovations. (Two of the participants declined to participate in this aspect of the study.) Following administration of the survey forms, open-end interviews were conducted with all of the participants to obtain additional information for interpreting and verifying the survey data.

During the following year, self-instructional modules produced by the participants applying principles taught in the institutes were obtained and examined. These materials represented the only primary source of data for assessing the extent to which the participants had mastered the principles of individualized multi-media instruction taught in the institute.

Toward the end of the academic year the Participant Followup Questionnaire (Form D) was distributed by mail to all of the original 28 participants to obtain data relevant to the impacts of the institute upon their subsequent academic

---

[1] All formal instruments used in this study are included in Appendix A.

performance. Telephone interviews were subsequently conducted with a sample of 18 participatants (64%) to stimulate returns and to obtain data for interpreting and verifying the survey data. Returns were obtained from 18 (64%) of the participants.

Sets of the Biology Student Reactionnaires (Form E) were distributed to the participants for use in their classes in which they had incorporated principles learned in the institute. The purpose of this survey was to assess the extent to which innovative practices had actually been adopted and their effects on student attitudes toward these courses. 14 class sets of this form were returned, representing 13 (46%) of the participants.

Finally, telephone and personal interviews were conducted with a sample of administrators and colleagues of the participants - Presidents, Deans of Instruction, and fellow teachers - representing 17 (74%) of the institutions included in the institute to obtain data pertaining to the level of awareness of the participants' work and the level of support provided toward adopting innovative teaching practices.

V. THE FINDINGS

Processes of the Institute

Initial findings established that the project's strategies were conceived on the premise that involving a number of California community colleges in a systematic program to update specially selected biology teachers in the current state of the discipline, and to train them to use new instructional technologies would contribute to improving biology education in several ways. First, the content and method of the participants' own courses were expected to be modified as a result of their experiences, thus enabling more biology students to learn current practices, principles, and information. Second, it was expected that each participant would influence the biology curriculum at his home campus by sharing his experiences with his colleagues. Finally, it was expected that the effects of the institute would spread also to the colleges' feeder, receiving, and parallel institutions, influencing biology education in nearby high schools and colleges.

Care was taken in recruiting and selecting the participants for the institutes. Announcements were distributed to biology teachers, heads of departments, and Deans of Instruction throughout the state and were presented at professional meetings likely to be attended by science educators. The original intent was to recruit one participant from each institution, relying upon institutional recommendations to help ensure some institutional commitment and to identify the most promising candidates (See Statement of Institutional Recommendation and Support, Appendix B).

Data from both interviews and questionnaires suggest that the methods used by the project staff in recruiting participants were effective. Nearly two-thirds of the participants learned of the project through direct mail, either from Golden West College or from the League for Innovation in the Community College. The other third learned of the project by word-of-mouth from fellow teachers, supervisors, and the announcements at professional meetings. Overwhelmingly (84%), the participants reported being motivated primarily by a desire to improve the method and content of their own courses and having received support from their home institutions to participate, in the form of salaried leave or release time. All the administrators interviewed had a high level of awareness of the project and the participants' subsequent teaching activity.

The participants' reactions to the workshop activities and their involvement in them were very favorable. All the participants indicated that they would re-enroll in the program again if they had the opportunity. More than 80% felt that most of their faculty colleagues could benefit from a similar experience, although they expressed reservations about the extent to which they could expect their home institutions to support innovative course development of the sort advocated in the institute. (It should be noted that 23 of the second summer institute participants were returnees from the previous summer. Investigation revealed that the two who had not returned had become too heavily involved on their home campuses developing new programs based upon the concepts learned in the previous year's institute. Three new enrollees were taken on, every one of them coming from institutions already participating in the project.)

Singled out for particular praise were those activities requiring the participants to become directly and actively involved in designing instructional materials, the blocks of unscheduled time provided during which they could develop their own ideas and projects, and the opportunities afforded in the institute for them to interact with colleagues, sharing experiences and testing new ideas. Negative responses were obtained with respect to the less participatory kinds of activities - listening to lectures, viewing television programs, and talking ABOUT teaching techniques (vis a vis practicing them). It appears that the emphasis on participatory workshops, on learning by doing, and on the development of individual projects was well-received by the participants, who overwhelmingly expressed preference for active over more passive types of activity.

When asked what might be added to improve future programs of this sort, participants' suggestions centered around both the content and methods of the institutes. Most felt that more emphasis should be placed upon the design of instruction, instructional methods and techniques, specification of objectives for biology courses, design of multi-media instructional programs, evaluation of learning, and less on presentations of specific biological information. Further, most felt that more supervised workshop activity should be provided, more professional evaluation of their production, and more opportunity for interaction and communication among themselves relevant to their instructional products and programs. Similarly, most recommended that formal lectures and information presentations be minimized since such information was freely available to them outside the context of the institutes.

Table 1 below shows the frequency of responses in each category of Form A, Part 1, representing how much time should be spent in various activities in the future.

Table 1

		MUCH MORE	SOME MORE	THE SAME	SOME LESS	MUCH LESS
1.	Field trips and excursions f=	1	4	16	4	0
2.	Discussion groups	2	14	8	1	0
3.	Group workshops and work sessions	1	9	15	0	0
4.	Lectures by experts and specialists	0	4	9	6	5
5.	Testing new teaching materials	2	9	13	0	1
6.	Preparing new teaching materials	0	7	17	1	0
7.	Interacting socially with colleagues	0	4	19	1	1
8.	Consulting individually with specialists and experts	1	9	14	1	0
9.	Individualized study and research	0	4	21	0	0
10.	Getting up to date in scientific subjects	0	4	15	2	3
11.	Learning new teaching methods	2	10	13	0	0
12.	Followup activities during the following school year(s)	4	11	7	2	0

N = 18

From these data it would appear that the participants were largely satisfied with the proportion of time spent in various activities in the institutes with the exception that significant proportions of participants expressed wanting more time spent in discussion groups, group workshops, testing and preparing new materials, consulting individually with specialists and experts, learning new teaching methods, and followup activities during the school year. A significant proportion of participants expressed wanting less time spent in lectures by experts and specialists.

To obtain a measure of the participants' general attitude toward the institutes a Likert-type summated rating scale was administered to the second summer institute participants (Form A, Part 2). The scale consisted of 12 scale items which allowed the participants to respond on a 4-point agree-disagree scale. Each response was rated on a 4-point favorable-unfavorable scale and these ratings were summated to obtain a single favorable-unfavorable measure for each respondent. The lowest possible scale value was 12; the highest, 48. The theoretical midpoint of this possible range was 30. For purposes of interpretation, the evaluators elected to consider any scale values between 12 and 30 (the lower theoretical half of the scale) as "unfavorable" toward the institutes; values from 31 to 48 (the upper theoretical half of the scale) as "favorable." The scale values actually obtained ranged from 32 to 45. The median value was 39 and the interquartile range from 36 to 41. Thus, all the participants expressed generally favorable attitudes toward the institutes as measured by this scale with the median participant being well above the mid- or "neutral" point of the scale.

Impacts of the Institutes

To determine the impacts of the institutes upon the subsequent academic performance of the participants, on the curriculum of their schools, on their colleagues, on their students, and upon nearby institutions, the evaluators conducted a mail survey of the participants toward the end of the subsequent school year (See Form D, Appendix A). The survey was supplemented by student reactionnaires administered by participants (See Form E, Appendix A) and by telephone and personal interviews conducted with a sample of administrators and colleagues associated with the participants. The following discussion summarizes the character of these impacts as they could be ascertained from these sources.

How have the participants modified the content and methods of their courses? The 18 respondents expressed 30 comments relevant to this question. 61% of the respondents reported using essentially the same content in their courses as they had previously without introducing any major changes. However, 44% of the respondents report introducing a number of minor changes in the content of their courses, such as providing more detailed information, reorganizing the content, and attempting to include more "relevant" content while excluding the "irrelevant." A number of participants report having introduced new courses following their participation - 22% of them. This was often described as a "splitting up" of content previously taught in a single course, so that certain portions of courses were becoming full courses in their own right.

A full 39% of the participants report that the major effect of the institute upon their teaching was in the use of self-instructional units, behavioral objectives, and audio-tutorial methods of teaching. 61% report using some forms of student evaluation to obtain feedback on their courses - general attitude toward the course and specific suggestions and recommendations to improve it. 56% report using some form of objectives-referenced tests to assess student achievement of the intended objectives of the course. 44% report using some alternative form of evaluation, often in combination with the above techniques, incuding monitoring attrition rates, colleaguial criticisms, evaluating student projects, and following up the success of students in follow-on courses.

Based upon the obtained responses, the respondents were rated according to the degree to which they had moved toward adoption of individualized, multi-media teaching methods. Table 2 reports on the proportion of participants rated at various points on this scale.

Table 2

Moved substantially toward individualized, multi-media instruction, either establishing courses in this mode, developing audio-tutorial facilities, or further developing existing audio-tutorial programs	33%
Moved significantly in direction of individualized, multi-media instruction through introduction of individualized study modules, behavioral objectives, frequent evaluation of student progress, and installing of accountability procedures.	50%
Moved slightly in direction of individualized instruction through some use of behavioral objectives, study modules, or criterion-referenced evaluation.	11%
Virtually no movement toward individualized, multi-media instruction	6%

N= 18

From the above it can be seen that 83% of the respondents returned to their institutions and moved toward modifying their courses in fairly visible ways.

To obtain an estimate of the knowledge and skills participants learned in the institute, the program modules produced by the participants were examined (see Appendix C, Titles and Abstracts of Program Modules Produced by UCI/GWC Project Participants). In general the modules, or self-instructional "Packages," were found to incorporate sound principles of instructional design, including 1) a precise statement of objectives, 2) graduated sequence of instruction, 3) frequent, active, and relevant practice, 4) confirmation/correction feedback to the learner, 5) opportunity for self-evaluation of progress, 6) conceptual mapping of the

learning task, 7) criterion-referenced post-testing, 8) appropriate illustrations, and the like. While some participants had developed greater proficiency in the preparation of the materials than others, it was evident that all of the participants were aware of the principles and their relationship to the learning process.

How have participants modified their attitudes and approaches toward instruction?

Seventy-five comments were received from the 18 respondents relevant to this objective. Their comments were classified and the proportion of respondents commenting in each category is summarized in the following discussion. It is noteworthy that 83% of the respondents reported returning to their institutions and employing more audio-visual and audio-tutorial materials, providing more opportunities for practice and testing, and lecturing less than they did previously. In some cases, whole new courses have been established based on these methods; in others, greater use of these methods within substantially traditional frameworks. In most cases, continued increased employment of these methods appears to be planned.

The increased use of these techniques does not appear to emerge as a simple "bandwagon" effect, since 56% of the respondents report use of these procedures in an "accountability" context - taking responsibility to assure that planned achievement actually occurs. 39% report use of these techniques in a context of "individualization" - providing for students to proceed toward their own targets according to their own abilities and needs and employing precise measures of achievement in relation to unambiguous statements of objectives. Additionally a variety of other attitudes is expressed. 22% of the respondents report feeling more confident, less frustrated, and better organized in their teaching than previously. 28% report that they now perceive teaching as a student-centered, rather than a teacher-centered activity and the teachers should emphasize what students do, not what teachers do. 39% express the feeling that all motivated students can learn and that it is the teacher's responsibility to assure that they do learn. And a belief in the value of individualized, multi-media instruction which takes responsibility for learning was expressed, in one form or another, by virtually every respondent. One reported coming to realize that there was no such thing as "traditional biology" since even biologists couldn't agree. Another expressed a deepened concern for achieving the higher order cognitive objectives. Two disclaimers also were expressed: one respondent expressed believing that the audio-tutorial approach should be part of the biology program, but should not dominate it. Another questioned whether the advocated approach would be useful in achieving affective objectives.

How have the participants' parent institutions modified their curricula, facilities, and level and nature of support for science instruction?

Data pertaining to this objective were obtained from both participants' surveys and interviews with administrators.

In the area of curriculum change, the responses of the respondents were classified in five categories of change. Table 3 below reports the proportion of participants responding in each of the categories as derived from their open-ended response. It should be noted that two of the institutionsrepresented here were already heavily involved in curriculum revision before the institute, so the impact of the institute *per se* is difficult for respondents to identify. Interviews with college administrators tend to confirm these data.

Table 3

Major change in curriculum: New courses introduced or total adaptation in one or more courses to audio-tutorial mode either planned or operating	44%
Some change in curriculum: Some content changes within existing courses; and/or some use of audio-tutorial methods within traditional courses	6%
Little change in curriculum: Some faculty experimenting within existing courses with behavioral objectives	11%
Virtually no change in curriculum	28%
Cannot evaluate because of existing high level of curriculum revision activity	11%

N= 18

In the area of facilities modification as well, five ordered categories of response were established and the proportion of respondents classified in each category is reported in Table 4 below.

Table 4

Major facilities modification: New audio-tutorial or similar laboratory established and/or conversion of room for this purpose.	39%
Some facilities modification: Much new instructional equipment acquired, and/or part of a room dedicated for use in audio-tutorial or similar mode	11%
Little facilities modification: Some new instructional equipment acquired	11%
Virtually no facilities modification	28%
Can't evaluate because of high level of existing installation of facilities	11%

N= 18

78% of the respondents reported receiving support from their institutions for their efforts to implement principles and practices learned in the institutes. The nature of these supports ranged from simple administrative encouragements and a "free hand" to develop and modify their courses as they felt appropriate to substantial allocations of resources. The most favored forms of support

appeared to be (1) provision of released time and/or summer stipends dedicated to the development of audio-tutorial programmed materials and related activities, (2) employment of instructional aides for the audio-tutorial laboratories, (3) dedication of space for the conduct of audio-tutorial lab activity, (4) allocation of budgeted funds for the acquisition and maintenance of audio-tutorial lab equipment, and (5) administrative encouragement. Interviews with a sample of administrators--college presidents and deans of instruction--corroborate their preference for these classes of support.

Responses from participants and administrators alike suggest that there was more in the way of administrative encouragement than material supports. Nevertheless, 72% of the participant respondents report some forms of material supports for their efforts. About 33% report major supports, including conversion of facilities, provision of instructional aides, and/or provision of released time or summer stipends for course development. This is consistent with the data derived from interviews with administrators. It was not possible, however, to determine how much of these supports were derived from intramural, vis a vis extramural, sources of funds; however, one dean commented that, "as a direct result of the NSF Workshop," his Board had voted funds to support the preparation of materials and the purchase of equipment for A-T Biology. Others awarded intramural fellowships to pursue similar activities.

Only 22% of the respondents report any change in budgetary supports for their biology programs - all increases. Thus it appears that the implementation of innovative programs is being accomplished primarily through reallocation of existing departmental funds rather than through new appropriations to the departments. One respondent reports that funds formerly available for supplies were now being redirected to maintain the laboratory machines. However, other sources of funds apparently are being tapped. Both participants and administrators report that extramural contract and grant funds are being used to fund both the equipment and staffing requirements of these new developments. In many cases, capital development funds are being used to establish audio-tutorial laboratory facilities and equipment in new buildings.

Have the participants' colleagues modified their academic performance as a consequence, either directly or indirectly, of the participants' experience?

This objective was concerned with the extent to which "spinoffs" from the individual's participation in the institutes could be observed in the performance of his colleagues, both at his own campus and elsewhere.

Of those who responded, 67% identified by name one or more members of their own faculty whom they believed have been influenced by them or their "modified" courses to make changes in their own courses consistent with the teachings of the UCI/GWC project.

22% of the participants either did not respond or responded "none" when asked to identify such influenced persons on their own faculty. One other responded that he had had such an influence, but declined to name the individuals. Several respondents were involved in conducting formal workshops with their own facilities as well as with other faculty members dealing with these principles.

Of those who did identify specific persons influenced by them, only one expressed a preference that the individuals not be contacted by the evaluators. There would thus seem to be a confidence among the respondents that these named faculty would confirm the participant's influence. Telephone interviews with several

of these named colleagues did confirm the respondent's influence. Of those who do identify specific "influenced" individuals, an average of 2.25 persons is named. Thus, on the average, it would appear that the participants are influencing one or two other persons at their own campus toward adopting the principles advocated in the institutes.

When asked to name individuals at other institutions who have been influenced by them or their courses, 78% of the respondents either responded "none" or did not respond at all. 17% responded by naming one or more specific individuals. One of the respondents (6%) responded affirmatively but could not name specific individuals because his college is so heavily involved in individualized, multi-media instruction. Another respondent named some 55 participants in a workshop which grew out of the UCI/GWC project and was funded through the vocational educational provisions of the Education Professions Development Act.

How have the attitudes and achievements of the participants' students been changed by their "modified" courses?

With respect to achievement, 24 relevant comments were returned by the 18 respondents. The comments were categorized and the proportion of individuals responding in each category is reported in Table 5 below.

Table 5

Unable to assess	33%
Have observed little if any change	11%
Have observed favorable change	56%

N= 18

Of those reporting observing favorable changes in the achievements of their students, 90% report clear increases in the proportions of As and Bs and corresponding reductions in the proportions of Ds and Fs awarded in their comparable courses in the past. One respondent reports an increase in the proportion of course completions over his previous offerings; however, three respondents report increases in the proportions of withdrawls.

It is clear that the introduction of individualized instruction of the type taught in the institutes has called for some new approaches to handling withdrawls. Apparently institutions have developed varied approaches to this issue. If the unmotivated or less able students become aware early of their lack of success in a course and are permitted or encouraged to drop without penalty during the term, the proportion of As and Bs may increase simply by attrition.

Apparently this approach has been used by some. Others apparently tend toward discouraging withdrawal and concentrate on improving the performance of these students. It would appear from the responses, however, that where student achievements improved in these reconstructed courses, the improvement apparently affected all students across the board, as the proportions of course completions with grades of C or better substantially increased.

Many teachers report conducting formal comparative evaluations of the changes in levels of achievement to back up their claims; however, only 12% provided the evaluators with any quantified response. Based upon these it is estimated that in these modified courses the proportion of As has increased 5-20%; Bs, 15-25%; the proportion of Cs has decreased 15-20%; and Ds and Fs have been virtually eliminated.

With respect to changes in student attitudes toward learning generated by modified courses, only 17% of the respondents reported failing to observe any evidence of attitude changes, acknowledging either that no evaluation of this dimension was conducted or, in one case, that no opportunity existed to evaluate the effects on students attitudes.

The participants offer little in the way of documentary evidence to support their reports in this area, but the fact that 83% express positive feelings about improved student attitude is noteworthy. If the students are "turned off" or respond negatively to an innovation, the teacher is quite likely to be the first to know it. The responses of the participants were categorized and the proportion of respondents responding in each category is reported in Table 6.

Table 6

Favorable changes in enrollments and withdrawals	50%
Other favorable interest related behavior: more active discussions, increased span of attention and activity, etc.	39%
Increased number and quality of special reports	22%
No observed changes in students' attitudes	17%
No response	6%

N= 18

Some corroborative data were obtained from college records. As an example, one instructor's student drop rate and grade distribution changed as follows:

Table 7

	Withdrawals	Percent Receiving As & Bs	Mean GPA
Prior Record	51%	35%	2.3
Following Workshop	41%	50%	2.6

N= Not Reported

His dean concluded that the instructor's "participation in the college Science Improvement Program did improve his teaching performance."

A Biology Student Reactionnaire was administered to samples of students in 14 "modified" courses (See Appendix A, Forme E). It was hypothesized, based upon the assumptions of the institute's rationales, that the extent to which innovative processes were introduced in a course would be positively related to affirmative student attitudes. Conversely, it was hypothesized that the extent to which traditional procedures were used would be negatively related to affirmative student attitudes. To obtain measures of the extent to which innovative practices had been instituted in these courses, vis a vis traditional practices, samples of students were asked to estimate the proportion of time they spent in various instructional activities. The median percentage of time reported in "Group Lectures" was taken as a measure of "traditional practice" for each of the classes reporting. The median percentage of time spent in "Programmed Instruction" was taken as a measure of "innovative practice" for each of the classes reporting. To obtain measures of student attitudes toward these courses, a Likert-type summated rating scale was employed using a 5-point agree-disagree continuum for each of six attitude items imbedded in a larger, 15-item questionnaire. Scale values of 6-30 were possible, the theoretical mid-value being 18. The median attitude value was taken as the attitude measure for each of the 14 reporting classes. A Spearman rank order correlation coefficient was calculated to express the relationship between these measures. No reliable correlation was found to exist between the amount of "innovative practice" and "affirmative attitudes" of the students. Neither was any reliable correlation found to exist between the amount of traditional practice" and "affirmative attitudes" of students. Thus, the expected relationship between student attitudes toward their courses and certain traditional and innovative practices employed in those courses could not be confirmed. On the basis of the evidence obtained from this survey of students, it might appear that attitudes toward courses are independent of these method-media variables. If this is so, then student attitudes toward courses may be more related to variables other than those specifically evaluated in this study and specifically addressed by the institutes. While these expected relationships were not confirmed in the study, it should be observed that the median scale value across all of these courses was 22.5, well above the

theoretical central value of the scale. This, together with the fact that the lowest median scale rating for any class was slightly above the theoretical midpoint of the scale, leads us to conclude that the students in these courses were largely satisfied with them. Further, examination of specific criticisms by those students whose attitude scores indicated general dissatisfaction with the modified courses reveals the following typical reasons for their criticism:

1. Poor organization of materials
2. Instructions not clear
3. Lack of facilities to perform requirements
4. Too much work for number of units earned
5. Inability to take responsibility for own activity. Need for more structure
6. Too much "busy work." "Doing" not always the best way to learn. Sometimes a simple verbal explanation would be enough.
7. Poor test questions. Don't always allow student to show what he knows.

How has articulation with feeder, receiving, and parallel institutions been changed as a consequence of the institutes?

Little evidence of any spinoff to other institutions - high schools, other community colleges, or 4-year colleges - was found in the study. Sixty-seven percent of the respondents report no interaction with individuals at such institutions. 22% report some minimal level of interaction, usually in the form of responses to inquires, showing and explaining their facilities to visitors, and some conversations with counterparts at these schools.

Two respondents (11%) report participating in the conduct of a 4-weekend workshop jointly sponsored by three community colleges, a community college district, and a county office of education on "Individualizing Instruction through Program Development." Individuals from five unified school districts, three high schools, and three other community college districts attended the workshop, which was funded by USOE under an EPDA, Vocational Education grant. Another has planned similar workshops, but primarily as an outgrowth of participating in another vocational education project (Project CISTRAIN) which focused on the training of change agents.

When asked if they could identify colleagues in other institutions who have been influenced by them to modify their teaching in ways consistent with principles advanced in the UCI/GWC project, 78% of the respondents could identify no such colleagues. 17% of the respondents were able to do so. One respondent claimed having such influence but was not able to identify specific individuals because of the heavy audiotutorial program at his own campus.

The evidence suggests that the workshop has had little effect upon articulation with other educational institutions.

What Relationship can be ascertained between the participants' personality traits and their receptivity to modifying their courses and functioning as change agents?

One concern of the study was to attempt to relate certain personality characteristics with the tendency to implement innovative teaching procedures. In this case, the Adaptive-Flexibility (A-F) Protocols (Brawer, 1967, Form C) were used to assess the relevant personality dimensions. (See Appendix D: Evaluation of Adaptive-Flexibility Protocols of Cooperative Science Improvement Project Participants.)

Subsequently, the scores obtained from these scales were correlated with staff predictions of participant adoptive behavior obtained following the institutes. Then toward the end of the subsequent school year, actual implementation ratings of the participants were made by a single rater based upon their Forms D & E, assessments of their students, and their own accomplishment reports. In a final comparison, the actual implementation ratings were related to the participants' attitudes toward the institutes as measured by an analysis of their Form A.

All four measures (staff predictions, A-F Implementation scores, attitude toward-the-institutes scales, and ratings of actual performance) were obtained from 16 (57%) of the original 28 participants. Table 8 on the following page reports the rankings of the various participants on these several measures. The rank-order correlations between the various measures are reported also in Table 8.

Table 8

Participant	Rank on Various Measures			
	W	X	Y	Z
	Attitude-toward-the-Institutes	A - F Implementation Ratings	Staff Prediction Ratings	Actual Implementation Ratings
1	13.5	13	15.5	16
2	16	6.5	9	2
3	1	6.5	4	10
4	4.5	13	9	4
5	9.5	13	9	3
6	2.5	2	9	8
7	4.5	6.5	13.5	12
8	11.5	13	1.5	14
9	7	6.5	4	11
10	11.5	6.5	15.5	13
11	13.5	2	9	7
12	6	13	9	1
13	2.5	13	4	5
14	8	6.5	1.5	9
15	9.5	13	9	6
16	15	2	13.5	15

N= 16

Rho_{wz} = +.23 Rho_{xz} = -.190

Rho_{xy} = -.011 Rho_{yz} = +.268

None of the above correlations is statistically significant

Based upon analysis of these data, the expected relationships could not be confirmed. Virtually no correlation was found between the A-F Implementation values and either staff predictions or actual performance ratings. Slight but unreliable positive correlations were found between staff predictions and actual performance ratings (RHO = +.268) and between attitude toward the institute values and actual performance ratings (RHO = +.23). From the available evidence it is not possible to conclude that the A-F Inventory employed in this study yet possesses the sensitivity necessary to discriminate high potential early adopters of innovations and/or change agents.

What specific criticisms, comments, and suggestions are made by those affected by the project regarding future projects of similar intent?

When asked to describe the major obstacles they faced in attempting to restructure established courses, reorganize the curriculum, or redesign teaching strategies in their community colleges, the respondents identified an array of difficulties. The major obstacle, as 65% of the respondents identified it, was the lack of operational support for such programs - lab assistants, access to computers, maintenance of test files, audio-visual production services, duplicating, typing, supplies and the like. Closely following in frequency, lack of their own time for the development and planning of restructured courses was named by 59% of the respondents. The same number also named lack of capital facilities for conducting A-T instruction.

Forty-one percent named faculty resistance as a major obstacle to modifying the curriculum and departmental approaches to instruction. Their own inertia (resistance? fear?) was named by 18% as a major difficulty in getting started. And 12% named conflicts with existing regulations governing grading policies and the required presence of the teacher at all times as a major difficulty at their institutions.

Mentioned, though less frequently, were lack of student discipline to handle the responsibility of individualized learning, their own fear of failure, and failure to gain the acceptance of colleagues.

In all, 94% of the respondents reported encountering obstacles of various kinds at their home campuses. One person claimed to have faced no obstacles.

What methods have these participants found to over the obstacles? Not many surprises, and certainly no breakthroughs were included in the responses. Just do it, they say, paying no attention to the obstacles. In a spiritual mode, they say "overcome!" In a practical mode, they say to be patient and explain to colleagues what you are doing as frequently and as candidly as possible. Be prepared to answer questions and seek support for your program in face-to-face encounters behind the scenes. Avoid public confrontation and adversary relationships. Be prepared to work overtime if needed and to spend your own money in the early stages.

Don't get discouraged, they say. Find a sympathetic colleague and work with him. The support of but one person can sustain you. Present a reasonable program, and don't try to move too rapidly. Don't get too far in front of your colleagues, just far enough that you make progress and that each step seems reasonable.

Pay attention to both upward and lateral communications. Keep both colleagues and administration informed of what you are doing. Seek their support and cooperation. Write grant proposals. Extramural support is often recognized more quickly as program certification. Intramural support may follow more easily thereafter. Be sure everybody gains--let everybody share in the successes when you have them. Don't hog the glory when it comes.

Looking back over the entire project, what specific suggestions and recommendations do the participants make regarding future institutes of this kind? Generally, the respondents were very supportive of this institute. Most of their suggestions proceed from the assumption that similar workshops might be held in the future and these are their major suggestions to improve upon them.

Several of the respondents asked for a more thoroughgoing reexamination of the goals of science education and, in particular, the role and function of the community college science curriculum within that framework.

Clearly, mixed feelings prevailed among the respondents with respect to the use of scientists and researchers in such institutes. They did not enjoy, nor did many express perceiving much value in the "lecture" approach used by the subject-experts in this institute. The majority expressed preferring more interaction with these subject-experts on recent advances in their fields, and more involvement with "hands-on" and "how-to-do-it" experiences.

Several mentioned a need for more interdisciplinarity in the science institutes - more opportunity to view the sciences against a backdrop of many disciplines.

There was a general expression of feeling that the institutes might focus more attention on the gentle arts of "grantsmanship." Most community college faculty members have had precious little experience in applying for extramural supports, and some systematic training and practice in this area they claim would benefit them. Similarly, some expressed the view that NSF might be more helpful in getting budgets turned around in favor of science education. Built in provisions for college participation in major projects was one of the methods mentioned along these lines.

Some mentioned individual interests in certain specialized topics and expressed interest in more shorter-term workshops on these more limited topics. For the longer institutes, however, such as this one, they expressed needing more interaction and technical support during the academic year between the summers.

Overall, however, the central thrust and conduct of this institute was reaffirmed often and enthusiastically.

VI. INTERPRETATION AND RECOMMENDATIONS

The processes and strategies of the UCI/GWC Project were most effective in generating and maintaining participant interest in revising course methods and in developing skill in applying recently developed principles and techniques of instruction to individualizing their courses. The institute generated some changes in course content as well, but not to the extent that it generated changes in the organization and methods of instruction.

The institute was also highly effective in modifying participants' attitudes toward instruction. There was widespread adoption of the use of objectives and a criterion-referenced approach with greater awareness of the need for instructor accountability for student learning. In addition, audio-tutorial methods were adopted by many of the participants.

Some limited spread of effect was observed among the participants' colleagues - some interest in the use of objectives, criterion-referenced instruction, audiotutorial methods, and an occasional trial. When observed, these effects tended to be within the participants' own departments, although isolated cases of wider influence were also discerned. In general, the impact of the institute on the participants' colleagues and counterparts appears to have been quite limited.

As to the conduct of the project itself, the summer institutes were directed in accordance with the proposal and the participants reacted about as might be expected. A high level of involvement on the part of the participants and directors alike was experienced. Except for two persons who had begun work on revising their courses on their home campuses, all the first year participants returned for the second year.

The selection of participants for the institute was well-conducted. Still, a great deal of appeal existed in the idea that innovations might be accelerated if persons could be selected for this training who had a high probability of becoming early adopters of innovations and/or change agents in their own academic communities. A test of the A-F Inventory as a possible tool for this purpose proved it unable successfully to differentiate among the participants on this basis. One explanation is that, because of the careful selection processes conducted by the directors, the group possessed a high degree of homogeneity on the relevant personality traits. This interpretation tended to be supported by the narrow range of variance obtained on the A-F Implementation ratings. As corroborative evidence of this condition, it was found that the institutes staff were unable, following the institutes, to predict reliably differences in the subsequent adoptive behavior of the participants. This supports the general notion that participants for similar institutes should be similarly carefully selected - indeed should be encouraged to select themselves - in order to ensure a similar high proportion of motivated participants.

Although the participants were quite active in revising their own courses and curricula during the year following the institutes, their influence on colleagues tended to be slight. While a few conducted workshops for other staff members

at their colleges, most spent their time primarily on their own programs. This suggests that if future institutes are to be directed toward the participants' influencing their colleagues, some provision for deliberate effort in this direction seems to be a needed component in the statement of work.

The evaluation revealed no indication that inter-institutional articulation was enhanced. Although some participants consulted with their departmental colleagues on innovative instructional processes, few if any made contact with biology instructors at other institutions. Thus, the institutes yielded little in terms of impacts on neighboring institutions.

The high level of increase in student achievement in the revised courses was most encouraging. Fewer withdrawals and a higher percentage of As and Bs evidenced a high degree of success in course reconstruction. The institute was most successful in this area, directly affecting student achievement and attitudes for the better. However, some apparent lack of student enthusiasm for the autoinstructional techniques was detected. This seemed to indicate a possible overzealousness in some cases in converting to the use of self-instructional methods to exclusion of other effective techniques, and before adequate preparations had been made. Some care needs to be taken in the conversion to an audiotutorial system to ensure that an appropriate level of planning and development of materials and resources has occurred prior to installation.

Furthermore, care needs to be taken to ensure that too much practice on trivialities does not turn effort away from essentials. Other studies tend to confirm the wisdom of using a "lean programing" approach - that is, the development of audiotutorial materials by adding, little by little, only that practice shown to be essential for effective learning. Without such care, we may find that an inept introduction of an audiotutorial system may lead to boredom, frustration, and attendant disaffection with the media form itself. This finding would be consistent with the findings of other cross-media and cross-method evaluation studies which tend to support the independence of attitudes from method and media variables.

It would appear, then, that teaching which favorably affects student attitudes toward learning may be conducted in both traditional and innovative modes. In other words, simply employing audiotutorial methods and multi-media presentations is no guarantee that students will come to love the course. Students quickly recognize poor teaching in whatever mode it is presented. The data from these studies suggest that to gain favorable influence over student affective response to a course, teachers must attend to more than mere methods and media of presentation. A careful selection and organization of the students' learning activities and experiences would seem to be at least as important as the choice of media for presentation and response.

Considering that the new courses evaluated in this study tended to be in early developmental stages, often in their first or second term of full scale implementation, the results must be judged to have been quite effective. The data point to substantial positive outcomes in both the cognitive and affective areas, and some increased efficiencies in the conduct of the courses. Some important

techniques and principles were introduced beyond simply the audio-tutorializing of courses. Some include the use of specific objectives, a criterion-referenced approach, developmental revision of courses based upon systematic, empirical evaluation, and built in provisions for instructor accountability for the results of instruction. This leads the evaluators to conclude that these new and reconstructed courses, in the main, have been successfully introduced and a sound basis has been provided for them to be strengthened and improved over time.

APPENDIX A

DATA-GATHERING INSTRUMENTS

UCI/GWC [illegible] SCIENCE IMPROVEMENT PROJECT

Participant's Evaluation Form A

Check the extent to which you feel one or more of the following activities in which we engaged as part of this project should be included in future projects of this kind. You may name others in the spaces provided.

1. Field trips and excursions					
2. Discussion groups					
3. Group workshops and work sessions					
4. Lectures by experts and specialists					
5. Testing new teaching materials					
6. Preparing new teaching materials					
7. Interacting socially with my colleagues					
8. Consulting individually with specialists & experts					
9. Individualized study and research					
10. Getting up to date in scientific subjects					
11. Learning new teaching methods					
12. Follow-up activities during the following school year(s)					
13.					
14.					
15.					

Check the extent to which you agree or disagree with each of the following statements about the UCI/GWC Project.	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE
1. Hasn't helped me with my teaching				
2. Was worth the time, effort, and money involved				
3. Has really influenced my teaching methods				
4. Has not led to any significant changes in my college's curriculum				
5. Has contributed to improved support for science teaching at home				
6. Has wasted a lot of my time				
7. Was very well planned				
8. Helped my understanding of recent developments in biology				
9. Could have dealt with more useful topics				
10. Could have left me with more things I could use during the year				
11. Gave me sufficient opportunity to participate in planning				
12. Didn't allow enough time for me to develop ideas of my own				

UCI/GWC COOPERATIVE SCIENCE IMPROVEMENT PROJECT

Workshop Evaluation Form B

As part of the program evaluation, we need your comments in regard to the following questions:

1. How did you first learn of the workshop?

2. What was your prime reason for getting involved with the workshop?

3. Why do you think the other participants came?

4. If you had it to do over again would you enroll?

   Yes _____ No _____

5. What single facet of the workshop did you find most helpful?

6. What facet was irrelevant or detrimental to your learning?

7. In your judgement what was most helpful for the other participants?

8. What would you suggest adding to future workshops of this type?

9. What proportion of the faculty at your own institution do you feel could benefit from a workshop of this type?

10. Using your own skills and interests as a benchmark, was the workshop paced and sequenced properly? Elaborate.

11. When you return to your institution, what new teaching techniques will you introduce?

12. How many other instructors at your college or neighboring institutions do you anticipate adopting portions of the techniques you learned or materials you prepared?

13. Any other comments?

UCI/GWC COOPERATIVE SCIENCE IMPROVEMENT PROJECT

Adaptive-Flexibility Inventory Form C

A-F Form B-2

Copyright 1967 by
Florence B. Brawer

DIRECTIONS

This is an exercise to see how different people react to different words.

You will find 180 words listed on the following pages. You are asked to respond to the words by writing down, in the blanks provided, the very first word or thought which enters your mind. Please do not question your own reactions but record your immediate impressions -- whatever they are. If a word doesn't quickly come to your mind, just go on to the next word.

This is not a timed task, however, please try to work as quickly as possible.

A-F WORD ASSOCIATION LIST

1. Cap _____
2. Glass _____
3. Smile _____
4. Style _____
5. Marriage _____
6. Cloud _____
7. Dream _____
8. Scream _____
9. Ambiguous _____
10. Desire _____
11. Liar _____
12. Entertainment _____
13. Enticement _____
14. Fear _____
15. Dear _____
16. Butter _____
17. Fly _____
18. Argue _____
19. Chattel _____
20. Anatomy _____

21. Peak _____

22. Neck _____

23. Fog _____

24. Frog _____

25. Sports _____

26. Campus _____

27. Cheat _____

28. Choke _____

29. Please _____

30. Tease _____

31. College _____

32. Fail _____

33. Satin _____

34. Sensitive _____

35. Ink _____

36. Group _____

37. Soup _____

38. Cock _____

39. Tail _____

40. Jealous _____

41. Complex _____

42. Conundrum _____

43. Dirt _____

44. Test _____

45. Integration _____

46. Fair _____

47. Anxious _____

48. Wonder _____

49. Full _____

50. Cold _____

51. Mask _____

52. Marble _____

53. Grade _____

54. Devotion _____

55. Hit _____

56. Needle _____

57. Bible _____

58. Mine _____

59. Clean _____

60. Law _____

61. Excitement _____

62. Work _____

63. Friend _____

64. Proselyte _____

65. Dance _____

66. Fun _____

67. Satisfaction _____

68. Bomb _____

69. Control _____

70. Symbol _____

71. Date _____

72. Late _____

73. Open _____

74. Abortion _____

75. Hammer _____

76. Head _____

77. Slush _____

78. Pest _____

79. Soft _____

80. Fat _____

81. Fete _____

82. Laboratory _____

83. Squeeze _____

84. Shadow _____

85. Punch _____

86. Pinch _____

87. Sea _____

88. Tough _____

89. Drink _____

90. Sink _____

91. Dare _____

92. Moon _____

93. Noon _____

94. Problem _____

95. Future _____

96. Bad _____

97. Red _____

98. Snake _____

99. Home _____

100. Blood _____

101. Judge _____

102. Tense _____

103. Line _____

104. Student _____

105. Beautiful _____

106. Face _____

107. Trap _____

108. Sap _____

109. Press _____

110. Flexible _____

111. Fight _____

112. Tight _____

113. Pass _____

114. Value _____

115. Me _____

116. Moiety _____

117. You _____

118. Attack _____

119. Touch _____

120. Duck _____

121. Luck _____

122. Fur _____

123. Love _____

124. Blue _____

125. Splice _____

126. Rat _____

127. Bat _____

128. We _____

129. Advise _____

130. Seek _____

131. Obedience _____

132. Table _____

133. Ideal _____

134. Love _____

135. Prude _____

136. Nut _____

137. Hut _____

138. Smear _____

139. Sterile _____

140. Nearness _____

141. Life _____

142. Blotch _____

143. Crawl _____

144. Win _____

145. Frown _____

146. Trouble _____

147. Wet _____

148. Pet _____

149. Ring _____

150. Virtue _____

151. Arouse _____

152. Study _____

153. Peace _____

154. Sink _____

155. Tomorrow _____

156. Rock _____

157. Sensation _____

158. Rod _____

159. Vice _____

160. Serendipity _____

161. Set _____

162. Met _____

163. Mate _____

164. Imagination _____

165. Period _____

166. Love _____

167. Soft _____

168. Career _____

169. Learn _____

170. Go _____

171. Permit _____

172. Black _____

173. Lay _____

174. Door _____

175. Soar _____

176. Egg _____

177. Life _____

178. Love _____

179. Time _____

180. Core _____

You've responded to a long series of varied words. Will you now please help us further by answering the following questions, as best you can?

Your name _____

1. What is your age?_____

2. Your sex? Male_____ Female_____

3. Highest degree?_____

4. Father's occupation?_____

5. Mother's occupation?_____

6. How many years have you been teaching?_____

7. Five years from now, what would you like to be doing?

_____

8. Ten years from now?_____

9. Which of the following age spans do you consider to be the happiest years of one's life? Please check one.

1 - 4 _____

5 - 9 _____

10 -14 _____

15 -19 _____

20 -29 _____

30 -39 _____

40 -49 _____

50 -59 _____

60+ _____

*E*R*A*

EVALUATION AND RESEARCH ASSOCIATES

2010 LINNINGTON AVENUE
LOS ANGELES, CALIFORNIA
(213) 474-2028 90025

12 May 1972

We are now completing the final stages of our evaluation of the University of California, Irvine/ Golden West College Cooperative Science Improvement Project in which you participated during 1969-71. Our intent is to ascertain the effects of the project upon your teaching practices and upon the curriculum at your school.

We need three types of information: 1) the ways in which you actually were able to put new concepts into practice since starting in this project, 2) your intentions and plans for the future, and 3) what difficulties you may have encountered in attempting to incorporate into your courses the teaching strategies and concepts taught in the project. In our report to the National Science Foundation we hope we will be able to recommend alternatives designed to overcome such difficulties in the future.

Please be assured that your responses will be kept in strict confidence. We will be trying to report an overall picture of the impacts of the project rather than personalized anecdotal information. Your frankness and candor will be appreciated and your anonymity respected.

You will find two types of forms enclosed with this letter. Please complete the Participant Followup Questionnaire (Form D) and return it to us by May 19, 1972, or as soon thereafter as possible. Please distribute the 25 copies of the Biology Student Reactionnaire (Form E) to a random sample of your students enrolled in a course in which you have incorporated concepts taught during the project. Have them complete the Reactionnaires, collect them, and return them to us by May 26, 1972, or as soon thereafter as possible. Stamped return envelopes have been provided for your convenience.

Appreciatively,

Marvin J. Rosen, Ed.D.
Arthur M. Cohen, Ph.D.
Co-evaluators

EVALUATION AND RESEARCH ASSOCIATES
2010 Linnington Avenue
Los Angeles, California 90025

(213) 474-2028

Form D

UCI/GWC COOPERATIVE SCIENCE IMPROVEMENT PROJECT
PARTICIPANT FOLLOWUP QUESTIONNAIRE

As you are aware, the general purpose of the National Science Foundation's Cooperative Science Improvement program is to improve the quality of science education. Institutions vary in their approaches to this task. The UCI/GWC Project, for example, focused upon improving the content and methods of biology instruction in community colleges by providing a two-summer long training experience for biology teachers representing over 20 California community colleges.

In our earlier interviews with you, we obtained your reactions to the workshops themselves, and to the conduct and content of the project. In this followup questionnaire we are primarily interested in the impacts of the project upon your teaching, and upon the instructional program at your school. We ask you to report any changes you have made in your approaches and methods which you attribute in large measure to the project. In addition, we ask you to report any observed changes in the knowledge, skills, and attitudes of students which may be attributed to these modified approaches. We will also ask you to report about other teachers who may have initiated new teaching procedures which appear to be a consequence of their interaction with you, or of their observation of your courses in action.

The questions are open-ended, so please feel free to include as much information as necessary to inform the evaluators. Use additional sheets if necesssary. MOST IMPORTANT: include examples and specific anecdotes to illustrate your general impressions and inferences. If possible, append any formal data you may have, such as summary records of dropout rates, grade distributions, standardized and classroom test scores, attitude or interest surveys, course evaluations, and the like.

Your cooperation is urgently requested in order that this final stage in the evaluation of the UCI/GWC Project can be concluded within the current school year. Please take a moment to complete the questionnaire now, and return it to us at the above address by May 19, 1972, or as soon thereafter as possible.

Many thanks,

Marvin J. Rosen, Ed.D.
Arthur M. Cohen, Ph.D.
Co-evaluators

UCI/GWC COOPERATIVE SCIENCE IMPROVEMENT PROJECT
Participant Followup Questionnaire

Form D

Name _____ Phone (Home) _____ (Office) _____

Employer (College) _____

Employer's Address _____ City _____

1. Describe any major changes you have made in the content of your biology course(s) which grew out of your participation in the UCI/GWC Project.

2. Describe any major changes you have made in your teaching methods, or in your course design which grew out of your participation in the UCI/GWC Project.

3. Describe any observed behavior of your students which you believe reveals attitude changes resulting from course improvements made since your participation in the UCI/GWC Project. (Include summary data if available on enrollments, drops, requests for tutoring, inquiries, special reports or projects, or other interest-related behavior.)

4. Describe any observed changes in the achievements of your students which you believe result from course improvements made since your participation in the UCI/GWC Project. (Include summary data if available on grade distributions, awards, honors, test scores, etc.)

5. In what ways, if any, would you say your attitudes, approaches to teaching, and teaching methods have changed as a consequence of your participation in the UCI/GWC Project?

A. Attitudes toward instruction:

B. Approaches to instruction:

C. Methods of teaching

6. In what ways, if any, has your college altered its Biology program as a consequence, either direct or indirect, of your participation in the UCI/GWC Project?

   A. Changes in curriculum:

   B. Changes in facilities:

   C. Changes in nature of support:

   D. Changes in level of support:

   E. Other changes:

7. From your own knowledge, has your participation in the UCI/GWC Project affected in any way the level or content of communication (or articulation) with any high schools, 4-year colleges or universities, or other community colleges? If so, give examples:

8. Describe what procedures you use to evaluate your teaching and the effectiveness of your courses. To what extent have these procedures revealed any changes which you believe result from your participation in the UCI/GWC Project? Include summary data, if available:

9. From your own knowledge, can you identify other members of your faculty who have been influenced by you or your courses to make changes in their own courses and methods consistent with the teachings of the UCI/GWC Project? If so, please list them by name and course title:

Name	Course Title(s)

You may contact the above if you wish ☐
I'd prefer you did not contact the above ☐
(Your preference will be respected.)
} Check one

10. From your own knowledge, can you identify colleagues in other institutions who have been influenced by you or by your courses to make changes in their own curricula, courses, or methods consistent with the teachings of the UCI/GWC Project? If so, please list them by name and institution:

Name	Institution

You may contact the above if you wish ☐
I'd prefer you did not contact the above ☐
(Your preference will be respected).
} Check one

11. In your judgement, what are the major obstacles one is likely to face in restructuring established courses, reorganizing a curriculum, or redesigning teaching strategies in a community college? Give examples if you can from your own experience:

12. Which of these obstacles have you encountered and what steps have you found successful in overcoming them?

13. Use the following space to give your specific suggestions, criticisms, and recommendations for future projects intended to improve science education in community colleges. Your comments may deal with any topics of importance to you.

14. We would like to interview other persons familiar with your work. Please identify by name and title some individuals we might contact who have been aware of your participation in the UCI/GWC Project and your subsequent activities.

A. _____ _____
Your department or division chairman — Phone

B. _____ _____
Your Dean of Instruction, or equivalent — Phone

C. _____ _____
Another teacher at your school — Phone

D. _____ _____
A colleague at a nearby high school or college — Phone

E. _____ _____
Any other person (unaffiliated with UCI/GWC Project) — Phone

15. Comparative Course Descriptions and Materials. Can you provide materials from your courses? We would like to see what kinds of changes you have implemented since participation in the UCI/GWC Project. Please send any materials you may have which would allow us to compare such items as course outlines, schedules, assignments, reading lists, and so forth before and after your participation in the project. (We are not interested in evaluating your courses, but in observing what kinds of changes you have made in them.) If course syllabi exist, we would appreciate receiving one. If before and after versions exist, we would appreciate receiving both. If you can't send the actual materials, describe the before and after differences in your courses as you believe them to be. (Note: do not send your self-instructional packages - we already have copies.)

16. If you have a course which incorporates science concepts and/or teaching methods taught in the UCI/GWC Project, we would like to obtain some reactions of students enrolled in it. We have enclosed 25 copies of a Biology Student Reactionnaire (Form E) for use in such a course. Please distribute these Reactionnaires to a RANDOM SAMPLE of students enrolled in the course and have them complete it. This can be done in less than 10 minutes. Then collect the completed Reactionnaires and return them to us under separate cover before May 26, 1972, or as soon thereafter as possible. A special return envelope has been provided for this purpose. (Note: Return Form E intact - do not separate the pages.)

-Many thanks for your help-

EVALUATION AND RESEARCH ASSOCIATES
2010 Linnington Avenue
Los Angeles, California 90025

(213) 474-2028

Form E

UCI/GWC COOPERATIVE SCIENCE IMPROVEMENT PROJECT
BIOLOGY STUDENT REACTIONNAIRE

We are conducting a survey of student reactions to certain biology courses as they are taught in California community colleges. We are trying to find out what methods of teaching are most effective and most preferred by students.

Your teacher has shown an interest in improving the effectiveness of this course and you have been selected to participate in this survey. Your frank and candid response to each question will be appreciated. Please use the back of the form to add any additional comments you wish to make.

This is a statewide survey and your reactions will not be used in assigning grades for your course work. DO NOT SIGN YOUR NAME TO THIS FORM.

Please complete the Reactionnaire and return it immediately to the person who gave it to you. We ask only a few minutes of your time.

-Thank you for your help-

UCI/GWC COOPERATIVE SCIENCE IMPROVEMENT PROJECT
Biology Student Reactionnaire

Form E

The title of this course is _____

It is offered at _____
Name of your school

Check the activities required of you in this course. Then estimate the approximate percentage of your time spent in each of the required activities. Some of the activities may not apply to your course. If that is the case, DO NOT CHECK those activities. Check only the activities which are provided for you in this course. If some of the activities provided are not in the list, add them in the space(s) provided.

ACTIVITY	APPROXIMATE PERCENT OF MY TIME SPENT IN EACH CHECKED ACTIVITY
☐ Group lectures	____
☐ Discussion groups	____
☐ Individual tutoring	____
☐ Reading (books, articles, etc.)	____
☐ Laboratory activity	____
☐ Field work activity	____
☐ Programmed instruction (audio-tutorial or other look-listen-read-respond methods)	____
☐ Moving pictures and/or television	____
☐ Demonstrations	____
☐ Writing (term papers, projects, etc.)	____
Other (please specify)	
☐ _____	____
☐ _____	____
☐ _____	____
TOTAL Must add to 100%	____

Below are statements of opinion about this course. You may agree or disagree with each statement in varying degrees. For each statement, place an "X" in the column which best expresses the strength of your agreement or disagreement. Please answer every item with a single "X". You may use the back of the form to express any other ideas or feelings you have about the course.

STATEMENT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. This course requires too much busy work.					
2. I always know what is expected of me in this course.					
3. This course is very interesting.					
4. I wish all my courses were taught this way.					
5. I hope I never have to take another Biology course					
6. I've learned more than I expected I would in this course.					
7. I get the individual help I feel I need in this course.					
8. I intend to take another Biology course sometime.					
9. This course is too structured.					
10. This course ranks among the best I have ever taken.					
11. I wish the course provided more guidance.					
12. I would describe this course as "learning by doing."					
13. I would prefer more lectures.					
14. I wish more time were given for special projects.					
15. I would like more individual attention.					

APPENDIX B

GWC-UCI TWO-SUMMER INSTITUTE FOR BIOLOGY TEACHERS

STATEMENT OF INSTITUTIONAL RECOMMENDATION AND SUPPORT

It is a goal of this institute that participants will return to their home institutions as effective change agents, stimulating the use of educational technology and systems approaches to teaching. The achievement of this goal depends heavily upon the recruitment of participants with a genuine interest, from institutions with a sincere commitment.

Please be frank. This report will be treated as strictly confidential. Please feel free to add additional sheets as necessary!

NAME OF APPLICANT: _____

Years of teaching the biological sciences at your institution: _____

Please provide any information about this applicant which you feel helps to identify him as a potentially successful innovator in his own courses, and as a change agent in his institution. Give examples of innovative ideas of the applicant. _____

_____

_____

_____

_____

_____

_____

_____

Please identify any special characteristics (weaknesses or strengths) about which we should know in order to work most effectively with this participant. _____

_____

_____

_____

Please identify here what the institution is willing and able to provide the participant toward innovational efforts. (Paraprofessionals, released time, flexible schedules of labs, lectures, or demonstrations, instructional materials, audio-visuals, etc.) _____

_____

_____

_____

YOUR NAME _____

POSITION _____

INSTITUTION _____

ADDRESS _____

Please Mail To:

Mr. Hayden R. Williams, Co-director
UCI-GWC, NSF Biology Summer Institute
Golden West College
15744 Golden West Street
Huntington Beach, California 92647

APPENDIX C

List and Abstracts of Self-Instructional

Modules Developed By Project Participants

AUTHOR: Bean, Carl D.
Sacramento City College
Sacramento, California

TITLE: SOLUTION CHEM & BIO-PHYSICO-CHEMICO CHARACTERISTICS OF CELL TRANSPORT

TARGET: Undergraduate Pre-Professional

CONTENT: The Cell membrane, types of solutions, methods of expression, concentration with problems, includes molar, normal, acid and base and how to determine the percent; diffusion, cell membrane permeability constants, mediated transport systems, (active transport etc.) the carrier hypothesis and osmosis.

FORMAT: Objectives, post test, script which includes instructive paragraphs followed by problems and some fill in questions, with specific reference to diagrams and a slide set.

AUTHOR: Burling, Edwin
De Anza College
Cupertino, California

TITLE: PROTEIN SYNTHESIS

TARGET: Majors

CONTENT: The student through questions and answers is guided through the process of protein synthesis, DNA, RNA, structure and function are also discussed. Through use of printed models the student constructs a protein.

FORMAT: Written script for student; molecular models printed on cards. Programmed approach includes objectives, questions and discussions, followed by short self tests.

AUTHOR: Dominguez, Gilbert M.
San Antonio
Walnut, California

TITLE: THE ORIGIN OF LIFE

TARGET: Non-Majors (Introductory Biology)

CONTENT: Special Creation Theory, Cosmozoa Theory, Spontaneous generation, Organic compounds from inorganic substances; Origin of a Cell; Heterotroph Hypothesis. The exercises pertaining to these topics are well supplemented with diagrams, charts and explanatory paragraphs. Most of the practice questions are fill-in or brief essay.

FORMAT: Teacher's Guide includes instructions for labs and an audio-script, a post test which consists of 59 multiple choice questions. Students Guide includes objectives, diagrams with related questions; and a bibliography.

AUTHOR: Galbraith, Robert T.
San Bernardino Valley College
San Bernardino, California

TITLE: ENERGY AND LIFE: FOOD PYRAMID I & II: FOOD CHAINS AND WEBS

TARGET: Non-Majors

CONTENT: Muscle function; energy, its importance to the body, calories, characteristics of living organisms, entropy, food pyramids and food chains.

FORMAT: All four packets include a list of objectives, discussion paragraphs and diagrams followed by fill-in questions; a post test with fill-in questions similar to those used in the discussion.

AUTHOR: Gilbertson, Lance

TITLE: THE METRIC SYSTEM

TARGET: Non-Majors

CONTENT: Packet aims at making the student proficient with tools of measurement, specifically the metric ruler, a triple-beam balance, a centigrade thermometer, and a graduated cylinder. The student also learns to do metric conversions.

FORMAT: Five objectives, the packet discusses each objective in detail and gives the student many practice problems. A post test where the student must demonstrate that they can weigh and convert the data accurately.

AUTHOR: Green, Peter

TITLE: ECOLOGY: FOUR MINI PACKS
1. Ecosystem
2. Populations and Communities
3. Terrestrial Ecosystems
4. Fresh Water and Marine Ecosystems

TARGET: Non-Majors

CONTENT: The program uses many different media. Mini pack # 2 utilizes the computer to determine population stresses, air and land polution, population problems. Mini-pack # 3 utilizes many slides about the different ecosystems in the area.
All the packs are intergrated with the text Fundamental Concepts of Biology by Boolootian, et al, (2nd edition).

FORMAT: Audio-script, objectives, slides, diagrams, student lab manual which contains many fill in questions that the student must answer while working with the tape, films, computer problems with predator-prey and population growth rates. Designed to take approximately 4 weeks.

AUTHOR: Griffin, Robert

TITLE: CLASSICAL GENETICS PART I, THE WORK OF MENDEL

TARGET: Non-Majors

CONTENT: Principal concepts developed by Mendel, principles of scientific experimentation and hypothesis formation as exemplified by Mendel's experiments.

FORMAT: A script intended for use either as a script for an audio tape or as a printed text; a set of illustrations which can be provided for the student either in booklet form or as slides; a student response booklet; objectives; 40 true-false question post test.

AUTHOR: Guinasso, Kenneth
Laney College
Oakland, California

TITLE: ECOLOGY (A SUB-SECTION ON BIOMES)

TARGET: Majors and non-majors

CONTENT: Discussion of major biomes, their physical characteristics; plants and animals of major biomes; man's influence; inter-relationships of organisms in each of the major biomes; adaptations of the biomes.

FORMAT: Short paragraphs with specific references to slides and maps; followed by short fill-in questions and then a discussion of the correct and incorrect answers.

AUTHOR: Hansen, Paul

TITLE: THE CELL STRUCTURAL BASIS OF LIFE

TARGET: Non-Majors

CONTENT: Historical background of the microscope and the cell theory; differences between plant and animal cells; detailed discussion of cell structure, function, and location of structures.

FORMAT: TEACHER'S GUIDE: Includes basic assumptions, i.e., background information about student knowledge; list of equipment needed for packet, outline of topics; and objectives.
STUDENT SECTION: Outline, pre-test, a student lab manual with many diagrams of plant and animal cells with related questions; a post test and an audio-script.

AUTHOR: Harkin, Arthur (Paul)
Foothill College
Los Altos Hills,, California

TITLE: BASIC BODY REGIONS AND TERMS OF ANATOMICAL REFERENCE

TARGET: Anatomy students (first semester)

CONTENT: Petite Pack # 8 is a casual but thorough approach to the organization of the skull. There is a step by step discussion of all the skeletal bones with reference to a skull that each student has checked out from the instructor. The packet uses "Textbook of Anatomy & Physiology" by Anthony as a reference throughout.

FORMAT: Cassette tapes, film strip, objectives, descriptive paragraphs of the skull structure followed by questions. Post test with many imaginative essay and fill-in questions.

AUTHOR: Kildebeck, Jack
Bakersfield College
Bakersfield, California

TITLE: CLASSICAL GENETICS

TARGET: Non-Majors

CONTENT: Packet discusses the following topics; sex-linked, chromosome crossing over, sex influenced, genes which lack dominance, genotype and phenotype in F_1 and F_2 generations, multiple genes and multiple alleles, blood group genotypes and phenotypes, non-disjunction, deletion and translocation of chromosomes with pictures and discussion of Klinefelters Syndrome, Trisomy 21, Trisomy X, and turner's Syndrome.

FORMAT: Objectives, discussion, numerous diagrams, essay post-test; four separate packages each with the same format.

AUTHOR: Moore, George L.
American River College
Sacramento, California

TITLE: THE CELL

TARGET: Majors

CONTENT: Packet consists of essentially three topics 1) history of the microscope; 2) Cell theory, Cell Structure and function; 3) Spectrophotometer, Principles, Applications and Use. Packet # 3 teaches the student the proper use of a Spectronic 20 and how to calculate the data gathered. Packet # 2 is a detailed discussion with diagrams of plant and animal ultrastructure.

FORMAT: The packet is introduced with a flow chart, followed by a list of necessary materials for lecture and labs; objectives relating to films being used, to organelles in living plant cells and the electron microscope. Script for week one, post test with a few matching, essay, fill-in, but mostly multiple choice questions. Student Packet includes: flow chart, objectives, reading assignments, bibliography, lab. exercises, index to 35 mm slides that are used.

AUTHOR: Newkirk, Gail
Antelope Valey College
Lancaster, California

TITLE: BASIC CHEMICAL AND PHYSICAL PROCESSES OF LIVING THINGS: FOUR MASTERY UNITS Also includes an introductory packet titled: YOUR GUIDE TO SUCCESS IN BIOLOGY

TARGET: Introductory Biology Students

CONTENT: Mastery Unit I: Introduction to Basic Chemistry, discussion of condensation theory of solar system formation; earth's age and physical conditions; formation of the first life compounds. The audio-script includes discussion, diagrams and questions which are integrated with the tape.
Mastery Unit 2: Discussions and questions related to electrical charge, atom structure, forms of energy, electron transfer.
Mastery Unit 3: How to read a Periodic Table; chemical reactions; valences, and bonding.
Mastery Unit 4: Empirical and Structural Formation, Balance Equations; Hydrophobic Interaction; Van der Waal bond; and equilibrium.
A Detailed Guide to Success in Biology could be used by any biology instructor as a preface to any course.

FORMAT: Includes an audio script for the student, a narrative for the instructor, illustrations (suggests a set of plates for each student), Criterion Exam for Learning Packet I contains 20 multiple choice, 20 fill-in questions and four brief essay questions.

AUTHOR: Paige, Charles D.
Cerritos College
Norwalk, California

TITLE: ECOLOGY WITH FOUR SUBTOPICS:
I. Variations and Adaptation
II. Physical Factors of the Environment Part I & II
III. Biotic Factors of the Environment

TARGET: All students

CONTENT: I. Variations and adaptations; balance of an organism with its changing environment.
II. Physical Factors of the Environment Part I discusses the terms biotic and abiotic, discusses aquatic and terrestrial environments, gives a definition of medium, substrata and inorganic nutrients.
III. Physical Factors of the Environment Part II discusses a) water adaptations; b) Influence of temperature and other environmental conditions; c) adaptations of warm blooded animals; d) plant adaptations to light.
IV. Biotic Factors of the Environment: a) niches; b) predation; c) biotic environment vs abiotic; d) Kettlewell's Study on Adaptations.

FORMAT: All four packets follow the same format: Objectives, vocabulary words, a student worksheet, materials list and discussion. A pre-test is being prepared, the post test consists of the objectives attached to each of the parts.

AUTHOR: Pederson, Lloyd
San Joaquin Delta College
Stockton, California

TITLE: CHARACTERISTICS OF LIVE, LOCOMOTOR STRUCTURE OF MICROORGANISMS

TARGET: Majors and non-majors

CONTENT: Characteristics of Life: Discussion of movement, metabolism, reproduction, growth and adaptation using a Paramecium as an example. The discussion is ended by a very intriguing question to test the student. Locomotor Structure of Microorganisms: Identification of cilia, flagella, pseudopodia, their structure and function, muscular contraction. Packet also includes a brief review of the microscope, using the Paramecium for live material. Uses film loops of Ameba and Planaria to demonstrate their mobility.

FORMAT: Both packets contain a list of objectives, a script, and a post-test.

AUTHOR: Price, George
Harbor College
Wilmington, California

TITLE: I. AN INTRODUCTION TO ECOLOGY: sub-topics, Characteristics of Life, The Community, Habitat.
II. THE ECOSYSTEM.

TARGET: All students

CONTENT: Definition of an ecosystem and description of various kinds; relationship of plants and animals to an ecosystem, food chain, its importance to an ecosystem. An Introduction to Ecology introduces the student to ecological terminology.

FORMAT: Introduction, objectives, discussion and questions, post-test.

AUTHOR: Rosales, Anthony J.
Consumes River College
Sacramento, California

TITLE: OBSERVING & MEASURING PROGRAM I

TARGET: Beginning chemistry students, and stockroom assistants.

CONTENT: Instructions for students in collecting data, methods of organizing data. Methods of measuring with a pipete, a ruler, a top loading balance and/or a triple beam balance. Calculation of density; a well organized approach to the tedious task of teaching students how to weigh accurately.

FORMAT: A step by step (hand-holding) discussion of methods of observation; post test, an audio-script and student work sheets. An easy reading and interesting approach to the correct methods of analysis.

AUTHOR: Rulon, Charles
Long Beach City College
Long Beach, California

TITLE: GROWTH OF HUMAN POPULATION

TARGET: Anyone who can read and has been through 8th grade math.

CONTENT: The intent of this packet is to instruct student on how to calculate birth, death and migration rates. It shows students how to interpret their data by use of graphs. It's main aim is to shock the student into concern about population.

FORMAT: Objectives, discussion and questions, a check list for each of the 19 objectives, a supplement packet that includes questionaires, reference books and data sheets.

AUTHOR: Schneebeck, Charles

TITLE: ARGUMENT, AMBIGUITY AND EXPERIMENT.

TARGET: Non-majors

CONTENT: Development, parts of an argument and practice writing each; the role of each, all this leads to the student performing an experiment to determine an oxygen source for fish sealed in a plastic bag.

FORMAT: Introduction, objectives, series of practice frames, and discussion, and a post test.

AUTHOR: Siegel, Monica E.
Palo Verde College
Blythe, California

TITLE: TAXONOMY OF FLOWERING PLANTS: Sub Titles: The Parts of the Plant
The Parts of the Flower
The Indented Key

TARGET: Students, adults, elementary teachers with a basic knowledge of botany.

CONTENT: By using Desert Mallow as a reference leaf, the student is guided through the proper use of a dichotomous key. The student is then tested with an unknown leaf. The other two packets discuss as their titles imply, the major parts of flowers and plants by using very detailed diagrams and slides of each.

FORMAT: Each packet includes: Objectives, a post test, diagrams, discussion of plant and flower parts, and a self-test.

AUTHOR: Thorpe, Darwin
Compton College
Compton, California

TITLE: HUMAN POPULATION AND THE STANDARD OF LIVING: IN TWO PARTS

TARGET: Any college undergraduate or graduate student.

CONTENT: Quotes from Paul Ehrlich on air pollution and a brief discussion of each. Questions to make the student wonder what over population means, and what conditions in our environment are the direct or indirect result of over population. (e.g. recreational areas, lack of jobs, air pollution) The first package's aim is to help the student establish where he is in the strata with respect to job and recreational satisfaction. The second pac is concerned with relating all national strata to the individual by using the Allen formula.

FORMAT: Packet # 1 includes objectives for both packs. Program is a series of paragraphs, newspaper clippings and problems relating to each.

AUTHOR: Verity, Suebelle
Los Angeles Southwest College
Los Angeles, California

TITLE: PARTS OF THE MICROSCOPE, A MINI PACKAGE
THE METRIC SYSTEM, A MINI PACKAGE

TARGET: Non-Majors

CONTENT: The Metric System, a mini package is broken into four parts: I) linear measures; II) weight; III) volume; IV) temperature. Each of these follows a format of "programmed" questions. The student is asked to measure something and then to perform metric conversion. The program includes the answers with it! The microscope--a mini package follows the same format where through numerous questions and reference to the diagrams of a microscope, the student should be able to learn all the parts and functions.

FORMAT: Each mini package is broken into mini objectives, discussion, diagrams with related brief essay questions, post test with specific instructions for instructor or course assistant, a script which calls for the use of a 35mm film strip. The mini-package, the Metric System includes a pre test where the students must demonstrate that they can do metric conversions.

AUTHOR: Walston, Wilbur L.
Cypress College
Cypress, California

TITLE: DNA, RNA, ENZYME STRUCTURE AND FUNCTION

TARGET: Majors

CONTENT: The packet discusses the term zygote, the function and structure of DNA, ribosomes, enzymes, RNA their functions and locations in the cell, codons and anti-codons and a brief discussion about vitamins and how some act as coenzymes. The packet assumes that the student is already familiar with many biological terms.

FORMAT: Objectives, diagrams, discussion with brief essay questions related to discussion paragraphs. A multiple choice post test.

AUTHOR: Wright, David M.
Porterville College
Porterville, California

TITLE: TERMS OF REFERENCE IN ANATOMY

TARGET: Sophomore paramedical majors

CONTENT: By using diagrams and many questions the packet familiarizes the student with the anatomical terms of position, movement, (abduction, adduction) direction and plane. Could definately be used in an Introductory Anatomy class or serve as a review for anyone in medical, nursing or related professions.

FORMAT: The packet is a supplement for the lab manual (A Laboratory Manual of Mammalian Anatomy and Physiology, by Grollman) includes a study guide, a script, a post test and objectives. The student guide includes many fill-in practice questions.

AUTHOR: Yale, Thomas
Bakersfield College
Bakersfield, California

TITLE: DNA & PROTEIN SYSNTHESIS IN FOUR MINI-PACKS

TARGET: Majors

CONTENT: The four mini packs are concerned with the following topics:

I. The gene as it relates to proteins, the chemical basis of the gene, the structure of DNA.
II. Duplication of DNA, DNA as the protein code
III. The need for Intermediate Compounds for Protein Synthesis, the synthesis of RNA.
IV. The types of RNA (survey), the Reading of the DNA code, Messenger RNA, transfer RNA and protein synthesis.

FORMAT: Each minipack includes: Objectives, script, post test. The script is for the student. It has practice exercises integrated in it. The answers for the practice exercises are on a separate sheet at the end of the packet.

APPENDIX D

Evaluation of Adaptive-Flexibility Protocols

Of Cooperative Science Improvement Project Participants

EVALUATION OF ADAPTIVE-FLEXIBILITY PROTOCOLS OF COOPERATIVE SCIENCE IMPROVEMENT PROJECT PARTICIPANTS

Florence B. Brawer

The Adaptive-Flexibility Inventory, a word-association technique designed to assess ego functioning in the "normal" adult, purports to measure specific demensions of this core concept: reboundability, toleration of ambiguity, intelligence, reality testing, both primary and secondary process associations, and the ability to "regress in the service of the ego".

It consists of 180 stimulus words to which the respondent reacts by writing his immediate responses. It is self-administering and takes approximately 20 minutes to complete. The A-F Inventory has been used with various groups of people: Undergraduate and graduate students, teaching interns, participants in encounter groups, and adults functioning in various professional fields. Interscorer reliability appears to be high with trained interpreters and positive concurrent validity has been established with A-F ratings and five approaches to Rorschach interpretation. In previous studies, Pearson r correlations were found to be significant (.05 level) for A-F ratings of beginning instructors and independent judges--i.e., junior college instructor supervisors. (Brawer & Cohen, 1966; Cohen & Brawer, 1967).

The A-F Inventory is scored according to a 7-point global rating which considers all associations to the stimulus words,

> To understand the meaning of the global assessment of ego strength on the 7-point scale, two points need special emphasis: (1) ego strength, like other psychological constructs, cannot be directly measured, and (2) in the absence of any direct means for measuring this core personality dimension, any indirect measures cannot be completely objective. With the

> A F scale, as with other psychological tools, much depends upon the interpreter, the kind of training he has had, and upon his ability to translate that training into practice. Much also depends upon the scorer-interpreter's understanding of individual dynamics, awareness of his own personality, his biases, and his particular focus of interests. Flexibility for one person might be considered a source of strength while for another, intellectual prowess is the key feature. (Brawer, 1967)

Tentative percentages have been postulated for the "normal" adult population, with 5% of the population assumed to achieve ratings of 1 and 7; 10% achieving ratings of 2 and 6; 15%,5; 20%,3; and 35% of the adults throughout the nation falling into the 4th category.

Subjects receiving one of the 7 possible ratings may be briefly described as follows:

7 - A person receiving this rating is seen as possessing an extremely high level of ego strength. He is creative and flexible; tolerates ambiguity; is able to offer intelligent, reality oriented responses and also, to regress when desired--using primary process associations which, in this context, suggest strength rather than weakness.

6 - This subject offers responses which are primarily reality-oriented and intelligent but not especially flexible or creative. Certain negative signs (e.g., perseverations, stress on complex areas, signs of suppression or repression, and an overly personal emphasis) may be present. In general, however, this person is independent, intelligent, and reality-oriented.

5 - A subject attaining a "5" rating is considered to be functioning at the top of the average group. He is fairly intelligent and, although somewhat constricted, steady rather than creative

or flexible.

4 - The "4" is usually accustomed to doing the right thing at the expected time. His responses are rather matter-of-fact and indicate average intelligence, with few emotional problems. At the same time, he tends to be banal.

3 - Word associations of the "3" respondent indicate dependence on defense mechanisms, immaturity, and constriction . This person has a tendency to be judgmental and reactive rather than open and independent.

2 - A rating of "2" suggests low ego functioning, either because of below-average intellectual ability or a preponderance of emotional problems. This respondent tends to be dependent, rigid, stimulus-bound, impulsive and, occasionally, not oriented toward reality. Repression and suppression are commonly used defense mechanisms.

1 - This subject is either overtly psychotic or so severely disturbed that he is hardly able to function in a "normal" society. The "1" who is able to respond to the A-F Inventory offers a preponderence of negative associations. His cues come almost solely from within and are unrelated to external reality.

The Cooperative Science Improvement Project

A-F protocols were administered to participants of the Science Improvement Project at the end of their workshop. All of these people were biology teachers in California junior colleges who were sufficiently interested in improving their own teaching to participate in the project. Two of these people declined to respond and 2 of the original 27 were absent. Thus, 23 protocols were completed. These were scored and

interpreted by the instrument's author according to directions for the A-F Global Rating. In addition, for purposes of this project, a second rating was assigned each subject--the Implementation Score. This was based on the interpreter's impressions regarding each subject's tendencies to implement the concepts he learned--i.e., his inclination to prepare self-instructional packages for his students, write objectives, and build audio-tutorial laboratories in biology.

While the A-F Global Rating applies to the individual in any setting, the accuracy of the Implementation Rating is directly tied to the teaching situation in which the subject functions. In practice, the amount of support the participants will receive for these activities will vary. Some presidents, deans, chairmen will go all out to aid in getting the labs built. Others will remain neutral. In some cases colleagues will be supportive; in most, however, they will be non-committal ("Well, if that's what he wants to do, I'll watch and see") or possibly antagonistic ("You build these devices for your students if you want but don't expect me to even visit the lab or take any part"). Accordingly, it is difficult to predict who will build his A T lab or prepare, administer, revise, and manage any forms of self-instructional material. A lot depends on the environment the instructor finds at his home campus, the amount of positive pressure his supervisors apply, and/or the negative reactions of his peers.

Assuming, however, that most instructors will find an open climate--i.e., "Do what you want, we'll help where we can"--combined with the institutional syndrome which holds that one instructor must not go too fast lest he engender peer disapproval, jealousy, and concomitant antagonism, the participant who does pursue self-instruction devices must be:

self-assured

convinced of the worth of A-T in causing student learning

dedicated to causing student learning (as opposed to sorting and punishing)

tenacious

willing to work beyond the damand of his job but realizing that he retains his position even if he does not pursue workshop-type aims

integrated and self-directed

independent of the need of applause from students for his personal attributes

not a "mediator" (Cohen and Brawer, 1972)

flexible

Given these conditions and these people, a 5-point system was devised, A through E, to assess Implementation tendencies. Subjects scoring A are seen as people who will do what they want, overriding any obstacles that may be encountered. "B: subjects will try to implement the workshop's concepts and methods but will need some encouragement from the setting. "C's" will do so only with a considerable amount of support, while "D's" may try for a month or so and then give up unless pushed to continue. "E's" are conceived to be individuals who participated in the workshop only under specific direction and who will implement suggestions, methods, etc. only if considerable pressure is exerted on them to do so.

Results

The A-F Global Score and the Implementation Ratings for the 23 subjects comprising this group are presented in Table I.

Table 1 here

Note that each person is given a numerical score but that not every one of the possible ratings has been utilized, as shown in Table 2's distribution of ratings.

Table 2 here

Table 3 shows the distribution of the Implementation Rating for this group; again, note the absence of the two lowest ratings.

Table 3 here

Table 4 presents the association between A-$\bar{F}$ and Implementation Ratings.

Table 4 here

It is evident that although high A-F scorers usually tend to attain high Implementation scores, this does not always pertain. Sometimes a high scorer on the A-F appears to be more intelligent and "steady" than creative and flexible; yet, a certain degree of flexibility is required for implementing changed procedures. In the interest of not wanting to "rock the boat," he may not be as willing to introduce and carry through innovative procedures. And finally, Table 5 presents the association of ages with both A-F and Implementation ratings.

Table 5 here

Statistically a test was made of the hypothesis that the two rating methods are independent. The Pearson correlation coefficient was computed to be 0.8578 and is significant at the 0.0005 level for a sample of size N=23. In addition two Chi-Square tests were made to determine if there is a difference in rating patterns of teachers divided on age. The sample was stratified into two age groups:those teachers 38 and older and those teachers 37 or younger. The X^2 statistic for the A-F rating scheme was 2.8192 while that for the Implementation rating was 0.0728.

Both values are not significant.

Discussion

Although the A-F scale is a fairly new research instrument, some reliability and validity have been established. It appears to be particularly useful with adults functioning in a professional setting. The Implementation score was devised just for these 23 protocols. It is suggested that a follow up assessment be made with the 23 subjects responding to the A-F, a few months after they have returned to work. Have they, indeed, implemented the working procedure? Do high A-F scores and high Implementation scores actually relate to tendencies to establish changed procedures?

TABLE 1

A-F Global Ratings, Implementation Ratings and Anticipations of Cooperative Science Improvement Project Participants

#	Sex	Age	A-F Global Rating	Implementation Rating
100	M	35	4	C
101	F	36	5	B
102	F	45	4	C
103	M	41	3	C
104	M	31	7	A
105	M	29	6	A
106	M	30	6	A
107	M	45	5	B
108	M	40	4	C
109	M	42	6	A
110	M	37	5	C
111	M	49	6	A
112	M	37	5	
113	M	33	5	B
114	F	30	6	A
115	M	44	6	A
116	M	39	6	B
117	M	32	6	A
118	M	29	4	C
119	F	over 21	6	B
120	M	30	4	B
121	M	42	6	A
122	M	38	5	B

TABLE 2

Distribution of A-F Ratings Among Workshop Participants

A-F Rating	Frequency
7	1
6	10
5	6
4	5
3	1
2	
1	

N=23

TABLE 3

Implementation Rating-Frequencies

Implementation Rating	Frequency
A	9
B	7
C	7
D	
E	

N=23

TABLE 4

Comparisons of A-F and Implementation Ratings

Implementation Rating	A-F Rating 1	2	3	4	5	6	7
A						𝍸 III	I
B				I	𝍸	II	
C			I	IIII	I		
D							
E							

N=23

TABLE 5

Comparisons of Age, A-F and Implementation Ratings

	A-F Rating							Implementation Rating					
	1	2	3	4	5	6	7	E	D	C	B	A	
over21						I					I		
49						I						I	
45				I	I					I	I		
44						I						I	
42						II						II	
41			I							I			
40				I						I			
39						I					I		
38					I						I		
37					II					I	I		
36				I	I						II		
35				I						I			
33					I						I		
32						I						I	
31							I					I	
30						II						II	
29				I		I				I		I	

N=23

REFERENCES

Brawer, Florence B., The Concepts of Ego Strength and Its Measurement Through a Word-Association Technique, (Unpublished dissertation, UCLA, 1967).

Brawer, Florence B. and Cohen, Arthur M., "Global and Sign Approaches to Rorschach Assessment of Beginning Teachers", Journal of Projective Techniques and Personality Assessment, 1966, 30, 6, 536-542.

Cohen, Arthur M. and Brawer, Florence B., "Adaptive Potential and First-year Teaching Success", Journal of Teacher Education, 1967, XVIII, 2, 179-185.

Cohen, Arthur M. and Brawer, Florence B., Confronting Identity: The Community College Instructor, Englewood Cliffs, New Jersey, Prentice-Hall, 1972.